Seeing the Whole Elephant

Envisioning a Successful Light Attack Program for the US Air Force

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Strategically, purchasing the OA-X in large numbers was probably one of the best things the Air Force ever did. It allowed us to balance our Air Force properly; project persistent airpower capabilities to places in the world that were previously very difficult to reach; started the construction of modern, combat-capable regional and national air forces where none had existed before; and provided a multirole capability that extended the life of fourth-generation fighters while we waited for the bugs to be worked out of the F-35 program. The current strength of the combat air forces comes from many sources today, but it is fair to conclude that without the OA-X, not only would the United States still be fighting the Long War in many more places, but the Air Force would have unnecessarily shed a great deal of capability in the past decade.

—US Secretary of Defense
Maxwell AFB, Alabama, 21 April 2018

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Acquisition of a capable, multirole, light attack capability by the US Air Force (USAF) is not a foregone conclusion. Faced with budgetary pressures, diminishing resources, institutional resistance, and acquisition-system challenges, advocates of reestablishing a light attack capability have encountered substantial difficulty in encouraging the USAF to start a credible program. Much of the work completed thus far has involved advocating for a capability, determining operational requirements, and defining the costs and timelines for acquiring light attack capabilities exemplified by the notional "OA-X" aircraft. This article does none of those things. In order to argue the vision effectively, this discussion paints the complete picture—an idealized view of a complete OA-X program that the USAF aggressively pursues, rapidly procures, and completes by the end of this decade. Written from a 2018 viewpoint, the article looks back on the success of the program.

In this case, *idealized* does not mean entirely free of resource constraints. Although the total fleet size remains undefined, it is considerably larger than the 15-aircraft buy currently envisioned by Headquarters USAF. Notably, the OA-X remains a complementary capability rather than a replacement for either legacy fighters or the F-35; the increased fleet size reflects the likelihood that the emerging demand for this capability will likely prove far greater than anticipated. In order to present a story of a completed program in a relatively short time, the article imposes minimal constraints on acquisition and basing; specifically, it assumes that the USAF can procure off-the-shelf aircraft to meet immediate needs and can base them in locations that make the most sense. Because we have not selected a light attack aircraft, the use of *OA-X* here keeps the discussion platform agnostic, without favoring any candidate.

The OA-X Aircraft

For the sake of simplicity, one OA-X exists, derived from an existing capability and purchased off the shelf with relatively minor modifications, mostly related to the installation of sensors and communications. Air Combat Command's (ACC) OA-X Enabling Concept outlines its capabilities.[1] A two-seat, low-wing monoplane aircraft powered by a single PT-6A turboprop delivering approximately 1,600 shaft horsepower, the OA-X can fly for three-and-a-half hours on internal fuel or five hours with two external fuel tanks. The aircraft includes appropriate radios, an option for data link (including variable message format, situational awareness data link, or Link-16 capabilities), and an electro-optical/infrared sensor that can provide video via a ROVER-compatible data link.[2] The OA-X can employ GBU-38 as well as GBU-12 precision-guided munitions and deliver tube-launched weapons and sensors. It is also capable of accurate, computer-aided delivery of unguided Mk-81 and Mk-82 bombs. AIM-9M Sidewinder missiles, 2.75-inch rockets (including precision-guided variants), and .50-caliber guns fill out the armament. Qualified aircrews can reload the rockets and guns in the field. The aircraft has a viable austere-airfield capability that allows it to operate, combat loaded, from any airfield 3,000 feet long and capable of accommodating a C-130. The hands-on-throttle-and-stick cockpit, roughly equivalent to that of any other fourth-generation fighter, includes secure radios and data links, compatibility with night vision goggles, excellent air-to-ground visibility, and ejection seats capable of functioning at zero airspeed and zero altitude. Chaff and flares provide self-protection, just as lightweight

armor protects the cockpit and engine. Notably, none of these capabilities requires a developmental effort; all of them come from other programs.

It is equally significant to discuss what the aircraft does not include. The OA-X can accommodate radar-warning gear, but only aircraft based at Nellis AFB, Nevada, and in Pacific Air Forces (PACAF) have that equipment installed. The helmet-mounted cuing system and the Hellfire, Maverick, and AIM-9X missile capabilities were part of a spiral development plan—not an initial requirement, as was a missile-warning sensor. Although the aircraft cannot transmit video from the sensors beyond line-of-sight, it does have UHF satellite communications and Iridium, but solely for voice.

All of the aircraft can accommodate signals intelligence sensors, but only limited numbers have them, the latter typically tasked to support US Special Operations Command (SOCOM). Some of them carry a communications jammer externally for special missions.

Genesis

By 2010 the OA-X concept had been under consideration within ACC for two years. Frustrated by the slow pace of events, the secretary of defense began a strong push for a rapid-acquisition program following the outcome of the 2010 Quadrennial Defense Review. Buoyed by emerging demand from overseas major commands, particularly United States Air Forces in Europe (USAFE), and under pressure to show some institutional commitment to irregular warfare, Headquarters USAF began a rapid-acquisition program in late summer of 2010 and "piggybacked" on the required delivery of 20 light attack aircraft to the Afghan National Army Air Corps (ANAAC) by the fall of 2011.[3] The USAF requested both additional funding from Congress and the authority to reprogram fiscal year 2010 funds to support immediate procurement of an off-the-shelf capability, suitably modified to meet its requirements (mostly related to weapons and communications). With strong support from the Office of the Secretary of Defense, Nellis AFB hosted a competitive flyoff among a small pool of nondevelopmental aircraft in the fall of 2010. Two contenders had potential, but only one reflected the state of development required by the USAF; consequently, the service signed a contract in the fall of 2010 that covered both the Afghan buy and the initial USAF purchase, with options for additional aircraft.

Continental United States

Following the success of phase two of the Imminent Fury (IF) combat demonstration of 2010 in Afghanistan, the USAF conducted an aggressive campaign to introduce OA-Xs into service, following an accelerated production and procurement schedule.[4] ACC accepted the first OA-X delivery in early 2011 and declared initial operational capability with the first 12 aircraft delivered at the end of the year. The first squadron stood up at Willow Grove Joint Reserve Base, Pennsylvania, following the previously scheduled retirement of the 111th Wing's A-10 Thunderbolts. Use of an Air National Guard (ANG) base allowed rapid stand-up of a field training unit (FTU) capability, and the choice of Willow Grove reflected the need to preserve the accumulated attack experience of the 111th Wing. This OA-X squadron, although formally designated a training unit, not only provided training capacity for both USAF and Afghan pilots but also operationally deployed two- and four-aircraft elements to support various operations overseas. In the summer of 2012, the aircraft was in high demand on the air show circuit, which offered both cross-country flight experience (particularly important for the Afghan pilots) and helped build public—and, therefore, congressional—support.

Mid-2012 saw completion of the Afghan buy and delivery of three aircraft each month to the USAF, with an additional one

aircraft per month going to the ANZUS (Australia, New Zealand, United States Security Treaty) OA-X program, a combined buy between Australia and New Zealand. The ANAAC lost two aircraft to pilot error in 2012, both of them replaced from new production. The aircraft acceptance rate for the USAF eventually grew to six per month. After the Turkish assembly facility came online in 2014, deliveries to overseas customers increased, with the USAF getting 50 percent or more of the total US production run of OA-Xs. Realizing that the AV-8B Harrier fleet was retiring faster than anticipated and faced with a major delay in the vertical-takeoff-and-landing variant of the F-35, the Marine Corps started OA-X procurement in 2013, successfully resisting pressure to buy Super Hornet aircraft that it did not want.

Today, eight years after the program began in 2010, ACC operates OA-Xs in five fighter squadrons, and the ANG has an additional five fighter squadrons similarly equipped, including both FTUs. Air Force Special Operations Command (AFSOC) operates a single squadron. ACC embedded squadrons within existing fighter wings to avoid the necessity of standing up new wings with their associated infrastructure and personnel. This method required only minimal additions to base populations and reduced the need for more military construction. The OA-X's small physical size, limited logistical footprint, and easy maintainability enabled existing facilities to accommodate it effectively.

Basing

The 2005 base realignment and closure had a significant impact on ANG force structure, realigning several fighter wings and assigning several more to fly C-21s as a "bridge" mission until the C-27J arrived.[5] Cuts to the C-27J program left several ANG flying units with no long-term mission and generated considerable enthusiasm for getting OA-Xs on the ramp. Two factors motivated basing strategy for the OA-X in the continental United States (CONUS): (1) the need to maintain proximity to Army and Marine Corps training facilities and (2) the presence of existing fighter wings, with the latter criterion more heavily weighted. For the ANG, the criteria remained similar although existing fighter wings containing units that had lost or would lose their attack capability received priority. Thus, of the 10 bases that currently operate OA-Xs, Battle Creek's 110th Fighter Wing (FW) is the only unit without close proximity to Army facilities since planners made a priority of retaining expertise as the A-10s moved out (fig. 1).

OA-Xs are assigned to four active duty wings and a fifth integrated fighter group (active duty and Air Force Reserve) at Moody AFB, Georgia, although the latter is a group in name only for heritage reasons. The preponderance of Army units in the Southeast gives that area heavy representation, with OA-X squadrons at Seymour Johnson AFB, North Carolina; Shaw AFB, South Carolina; and Moody. Nellis AFB operates the 561st Fighter Squadron, again the sole operational fighter unit there, as well as the OA-Xs assigned to the 422nd Test and Evaluation Squadron and the Weapons School. Mountain Home AFB, Idaho, houses the final active duty unit. One four-ship operational detachment, deployed at Reagan National Airport since 2012, shares ramp space with the Coast Guard, conducting routine training with federal agencies in a complex urban area defined by the flight-exclusion zone around Washington, DC, and occasionally supplementing the 113th Fighter Wing at Joint Base Andrews, Maryland, for air defense alert. More cynical observers have also pointed out that the presence of this detachment offers senior leaders in Congress and the Office of the Secretary of Defense visible proof of the USAF's commitment to irregular warfare; orientation flights are rather common.

AFSOC operates its OA-X squadron at Cannon AFB, New Mexico. The Marine Corps squadrons are at Yuma, Arizona, and Cherry Point, North Carolina, while the Na-

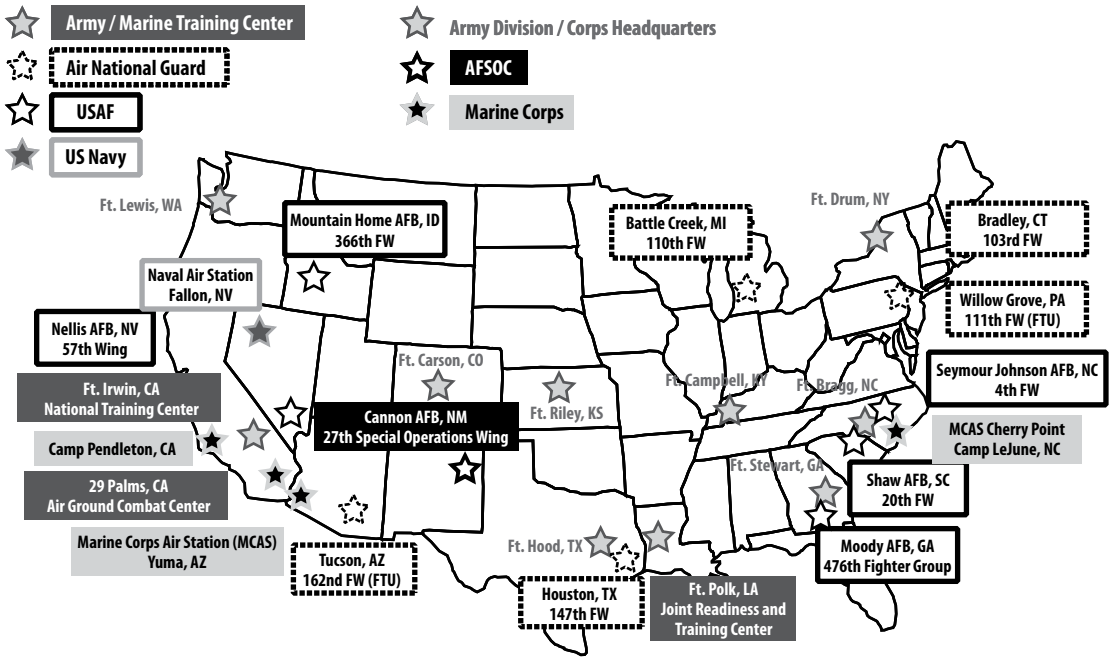

Figure 1. CONUS basing of OA-X aircraft

vy's sole squadron operates at Naval Air Station Fallon, Nevada. Two OA-Xs are assigned to the 85th Test and Evaluation Group at Eglin AFB, Florida, mostly for testing and weapons-integration work.

Training and Crewing

As expected, the OA-Xs were pressed into combat operations, virtually as soon as the USAF took delivery of the airframes, and the availability of experienced rated officers became a hot issue due to the existing shortage. The IF combat demonstration, shared with the Navy, gave the USAF an initial cadre of three combat-experienced crews by December 2010. Extension of the combat demonstration sent another three crews into the IF pipeline, a process that continued until the IF "detachment" became a Navy attack squadron in 2012. An unofficial exchange program established with the Colombian Air Force kept the initial cadre's skill sets sharp. When the FTU opened at Willow Grove, two Colombian instructors, present from the beginning as exchange officers, helped build an extremely successful formal relationship that has become both larger and multilateral.

The rapid drawdown of ANG fighter units produced an abundance of volunteer ANG pilots. Willow Grove had many pilots to choose from since a number of guardsmen were willing to commute substantial distances for the opportunity to be on the leading edge of a new program. The proximity of Willow Grove to Philadelphia had an unexpected side benefit—ANG pilots who were current or furloughed commercial airline pilots could easily commute into Philadelphia International Airport from significant distances. The instructor corps remained the bottleneck, but the IF crews, experienced ANG instructor pilots, and Colombian instructors opened up the pipeline much more quickly than anticipated. The USAF benefited from advanced planning

between ACC and the National Guard Bureau, which had anticipated the need and identified necessary resources well before the first aircraft arrived.

If volunteer pilots were abundant, weapons systems officers (WSO) were not—despite a number of enthusiastic volunteers—because of the limited availability of suitable candidates. The on-again, off-again nature of Specialized Undergraduate Navigator Training restricted the number of available fighter WSOs, and the lack of a two-seat fighter in the ANG left only very senior officers with F-4 Phantom time in the 1990s as potential ANG candidates. Thus, it fell to the active duty force and Air Force Reserve to supply fighter WSOs. To some extent, three concurrent efforts mitigated the acute shortage of WSOs: (1) a limited-period recall program from both the active Reserve and the participating Individual Ready Reserve, (2) a program to reassign WSOs who were manning staff positions CONUS-wide, and (3) a migration of fighter-experienced WSOs from remotely piloted aircraft (RPA) squadrons. Understandably, the last two programs received more volunteers than the Air Force Personnel Center was willing to reassign. The resulting initial WSO force for the OA-X resembled the initial F-15E WSO cadre from 20 years before—a few new lieutenants and a surplus of majors and lieutenant colonels who had called in every favor ever owed them to get into the airframe. AFSOC did not suffer the same problem because it had slightly differing requirements and only a single squadron to fill; moreover, it used both navigators and electronic warfare officers from its AC-130 gunships.

Making a virtue of necessity, ACC continues to man the OA-X squadrons at a higher ratio for pilots than WSOs, even now that both pilot and navigator training has been running at full output since 2011. The official rationale for doing so is that OA-X units employed in operations will often fly host-nation personnel (aircrews and others), joint terminal attack controllers (JTAC), ground personnel, and even linguists in the backseat, which requires a lower WSO-to-airframe ratio. The side effect is that in training, WSOs fly more sorties than pilots, a condition commonly referred to as the "WSO bonus."

The OA-X squadrons established at F-15E bases are unique in that a select number of crews dual-qualify in both the F-15E and the OA-X. This program sought to provide a companion aircraft to mission-ready crews and allow them to meet sortie requirements for proficiency while flying a less expensive airplane. As a side benefit, it allowed the F-15E wings to increase their ability to absorb new aircrews. Although successful enough to continue, the program has not expanded to other aircraft types. Essentially, the F-15E crews have divided into two bands of capability within the squadrons. On the one hand, crews that fly the F-15E exclusively tend to become instructors faster in that aircraft, and only those crews can maintain proficiency in certain weapons, including the GBU-15, AGM-130, and GBU-28. Crews qualified in both the OA-X and the F-15E, on the other hand, have an opportunity to accrue flying hours and obtain combat experience faster—an attractive prospect. The OA-X crews maintain proficiency as forward air controllers (airborne) (FAC[A]), which the F-15E Strike Eagles could not support; the F-15Es' FAC(A)-qualified crews are all dual-qualified.

The 147th Fighter Wing at Ellington Field, Texas, also maintains dual-qualified aircrews—but in the MQ-9 Reaper (originally the MQ-1 Predator) as well as the OA-X. Once again, this reflected acceptance of necessity rather than a planned option. That is, because an OA-X squadron was needed in close proximity to Fort Hood and because the 147th had already lost its fighters and transitioned to MQ-1s, OA-Xs were brought in without giving up the RPAs. This move also resulted in an unusual mix of capabilities in that WSOs also serve as sensor operators in the RPAs. The model did not expand, however, since the rapid influx of OA-Xs reduced the number of fighter WSOs available to RPA squadrons, and those

heavily tasked units generally stayed too busy to fly a companion aircraft.

Combat Operations

After the success of IF, nobody was surprised when OA-Xs participated in combat operations before the first squadron formally achieved initial operational capability. A four-ship became a permanent detachment at Kandahar Air Base (AB), Afghanistan, in 2011, allowing the IF birds to relocate to various sites in support of special operations. Crews rotated in and out as necessary while the OA-X remained in Afghanistan. Because of the ease of maintenance, the aircraft rarely had to return to the United States.

Afghanistan operations relied on a hub-and-spoke arrangement from Bagram AB and Kandahar AB. Although the main detachments occupied the asphalt-paved airfields, the OA-Xs made excellent use of smaller airstrips, including the gravel strips that compose the majority of airfields in Afghanistan. Aircraft commonly flew out-and-back operations, launching from the main operating base, flying a mission, landing at a forward base for refueling and limited rearming, launching again with the same crew for a second sortie, and returning to base at the end of the crew duty day. For certain missions, especially FAC(A), aircrews could land at the forward operating base (FOB) and perform the detailed face-to-face coordination required by the supported ground commander. Typically, aircrews refueled and rearmed by using the linked .50-caliber ammunition and 2.75-inch rockets that are ubiquitous at Army-controlled airfields.[6] The fuel requirements of the OA-X—less than 5 percent those of the F-15E—enabled trucks to supply forward bases. More than one OA-X got refueled from 55-gallon drums with a hand pump. When the United States lost permission to operate tankers from Manas AB, Kyrgyzstan, during lease-renewal negotiations in 2015, additional OA-Xs deployed to Afghanistan by C-17 and directly from North Atlantic Treaty Organization (NATO) units, taking over the lion's share of close air support (CAS) taskings. From that point on, even after we regained access to Manas, the OA-X always constituted at least 50 percent of the fighter fleet in Afghanistan.

The OA-X rapidly became the preferred aircraft for flying armed reconnaissance and overwatch missions. The aircraft's endurance enabled OA-X elements to maintain two-ships overhead longer than legacy fighters. In a typical eight-hour period, both OA-X aircraft were available for six of those hours, each having to refuel only once—usually from a nearby forward arming and refueling point. The fact that OA-X detachments would operate from either Army- or Marine-owned FOBs for days at a time in support of ground operations gave aircrews direct exposure to the units they supported, raised the confidence level of participants, and facilitated the detailed integration and planning necessary for a successful air-ground team. Both Army and Marine commanders and liaison officers would regularly fly in the backseat of the OA-X, providing valuable perspective for everyone involved. In a two-ship of OA-Xs, a single "rider" was considered the operational maximum. Such a formation would typically have the rider in the wingman's aircraft; the WSO in the lead aircraft could laser-designate weapons for either aircraft, offsetting the impact of having an inexperienced rider.

With regard to the deployment of OA-Xs, one valid concern involved the difference in response time between those aircraft and the legacy fighters, due to airspeed considerations. OA-X basing strategies only partly mitigated this concern, given the small number of those aircraft deployed and the fact that available bases outnumbered the OA-Xs. As the number of in-country aircraft increased and their distribution became more dispersed, response times eventually equaled or beat those of jet fighters in the areas closest to concentrations of major International Security Assistance Forces (ISAF). From ground alert, OA-Xs quickly

became airborne, often taking off less than five minutes after the crew touched the airplane and beating the jets into the air. The Afghans rapidly adopted this model for their own CAS missions and effectively covered the entire country with ground-alert aircraft based at Shindand, Kabul, and Kandahar (fig. 2).

OA-Xs provided CAS, FAC(A), rescue escort, and armed reconnaissance missions for both general-purpose forces and special operations forces (SOF). FAC(A) capabilities, historically underutilized in Operation Enduring Freedom, became commonplace after the success of IF in 2010. As predicted, SOCOM placed a high demand on the few OA-Xs available. For once, SOF did not have first priority on an available aircraft because daylight operations for general-purpose forces had priority; consequently, SOF largely had to make do with gunships, legacy fighters directly tasked to support them, and IF aircraft. This tug-of-war led directly to the stand-up of an AFSOC squadron and formation of the Navy's single light attack squadron.

The introduction of similar OA-X squadrons from several nations, combined with the Afghan acquisition, made the majority of fighter aircraft at Kandahar OA-Xs. One notable photo arranged by the Kandahar Air Expeditionary Wing features Colombian,

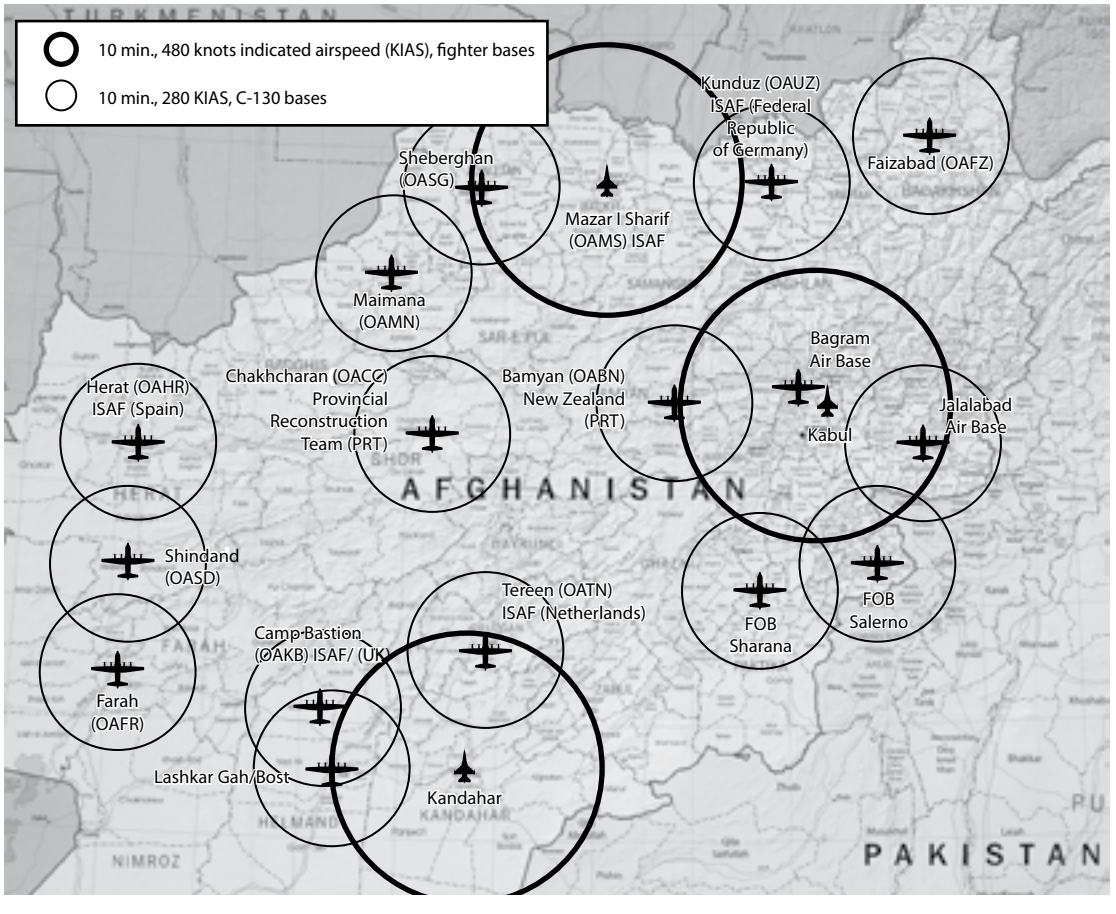

Figure 2. Coverage of Afghanistan with ground-alert aircraft

Afghan, NATO, Royal Air Force (RAF), USAF, and US Marine Corps OA-Xs in front of the old control tower. The commonality of the aircraft made it easy to "drop in" on other OA-X locations for a full rearming; instituting NATO Ample Train procedures for ISAF allowed load crews to put any available authorized munition on any OA-X.[7]

SOF had to accept a lower priority on OA-Xs in Afghanistan, but that did not apply in the rest of the world. The ability to load a four-ship of OA-Xs into a C-17, fly to a destination, and reassemble the aircraft within four hours of landing was a SOF dream. The Australian Special Air Service eagerly followed SOCOM's example. As early as 2012, aircraft assigned to the FTU at Willow Grove would disappear for a week or two at a time and then reappear weeks later in serviceable condition, smelling faintly of cordite and low-quality fuel residue. The havoc this played on training schedules was partially offset by temporary utilization rates that would have shattered a legacy fighter squadron; once again the maintainability of the aircraft and the hard work of the ground crews paid dividends.[8] The fact that each squadron consisted of 24 aircraft also helped them support simultaneous training and deployments.

Operating attack aircraft in areas of the world without 8,000-foot asphalt runways (and, consequently, with little possibility of persistent support from USAF or US Navy fighters) characterized the OA-X's support of unconventional warfare. Special operations support produced several innovations later adopted by the OA-X squadrons. The use of linguists and a signals-intelligence package, pioneered by the Ellington Field ANG unit in partnership with the Army Reserve in Houston, was readily adopted by AFSOC and the OA-X unit at Shaw AFB, which had ready access to the Defense Language Institute at Fort Jackson, South Carolina. As a result, the Ellington Field ANG unit became the preferred ANG squadron for AFSOC and improved the retention of linguists in the Houston Army Reserve. Unanticipated capabilities came to light after an unfortunate test mishap with a flare-sized jamming package on the Eglin AFB range led to the local disruption of cell phone networks. Though officially a mistake, the incident motivated the rapid prototyping of a capability that AFSOC eagerly adopted by procuring specialized jamming kits. These aircraft-powered units fit into the aircraft's existing ALE-47 magazines with only minor modifications, sacrificing eight flares out of a normal load of 60 in return for a jamming package on both sides of the aircraft. OA-Xs have also led the Department of Defense in adapting tube-launched weapons, sensors, air-deployed RPAs, and even expendable airborne communications relays. The low airspeed of the OA-X, compared to that of high-performance aircraft, significantly reduces launch stresses for tube-launched payloads and poses a much more surmountable engineering challenge. Of note, tube payloads for the OA-X and MC-12 aircraft are designed to be completely interchangeable.

No discussion of combat operations would be complete without addressing survivability. Early in the program, many analysts doubted the survivability of such a "low-performance" platform, yet these reservations did not arise from a firm appreciation of the threat. The A-10's slow airspeed did not measurably increase the rate at which it suffered hits from antiaircraft artillery in an environment where squad-level aimed fire from small arms represented the primary threat. In most cases, small-arms hits on OA-Xs were a result of making multiple passes from a predictable attack axis, precisely mirroring the previous combat experience of other attack platforms. Small-arms damage is uncommon enough that many air forces have removed the armor from cockpit walls to save weight, but most of them retain the armored cockpit floors and engine protection.

The aircraft has proven very difficult to hit with man-portable air defense systems, and no OA-X—tactically flown with an operational missile-warning system and flares remaining—has been hit by an infrared missile. The prop wash tends to diffuse the air-

craft's exhaust plume rapidly, and its slow speed limits the heating of the airframe's leading edge, greatly reducing the opportunity for infrared-guided missiles to lock onto the OA-X from a position forward of the aircraft.

Fleet Growth: Overseas Major Commands

USAFE, which had made an early pitch to get the first four OA-X squadrons, had to settle for the third and sixth, although both were 24-aircraft squadrons rather than the 12-aircraft units that European Command had requested. The need to establish a stateside FTU, the drawdown of the ANG fighter force, and the urgent demand for the OA-X in Afghanistan prompted commanders to give the CONUS buildup high priority. Nevertheless, USAFE reactivated the 495th Fighter Squadron at RAF Lakenheath in 2012 and the 480th Fighter Squadron at Spangdahlem AB, Germany, in late 2013. Taking a cue from the ANZUS binational purchase, USAFE encouraged the formation of two additional squadrons in Europe, the first a NATO attack squadron modeled after the alliance's successful Airborne Warning and Control System and C-17 squadrons. Having recently reentered the NATO command structure, France offered to host the squadron at an air base near Nice on the Mediterranean coast, which proved irresistible to the NATO staff at Brussels and ensured that the unit would never lack for volunteers. The unit has seen extensive combat experience supporting the ISAF in Afghanistan and maintains a close relationship with the Nigerian, Moroccan, and Egyptian OA-X squadrons.

The second European multinational squadron took much longer to form, not reaching initial operational capability until 2017. This unit, a cooperative effort among Estonia, Latvia, and Lithuania, is actually oriented towards training, surveillance, and air policing rather than ground attack. Taking advantage of the transferrable, affordable, modular, interoperable capabilities of the OA-X, the Baltic OA-X is a "sport" version without precision air-to-ground capability; however, it comes equipped with guns, AIM-9Ms, an infrared sensor, and Link-16. This selected set of capabilities both tailored the aircraft to unique needs and reduced the overall program cost by several million US dollars per airframe over the life of the program.

A relative latecomer to the OA-X program, PACAF may well have been inspired by the South Korean KA-1s, fielded as FAC(A)-capable observation aircraft. PACAF currently operates three 18-aircraft squadrons—two in Korea (at Osan AB and Kunsan AB) and one at Eielson AFB, Alaska. All PACAF aircraft have ALR-69 radar-warning gear installed, primarily due to the nature of the North Korean air defense threat. Despite initial doubts about the OA-X's survivability over North Korea, planners rapidly integrated the aircraft into war plans after realizing that every combat sortie flown by an OA-X over South Korea freed a jet aircraft to go north. PACAF units have turned the annual Cobra Gold exercise into a virtual OA-X convention since the exercise regularly attracts OA-Xs from throughout the region; even Korea-based OA-X squadrons spend a significant amount of time traveling to other countries in the Pacific region to build aviation partnerships.

Other Services and Agencies

As previously mentioned, both the US Navy and Marine Corps operate the OA-X. The Navy's aircraft, located in a single land-based squadron at Naval Air Station Fallon, support its special warfare units. Direct successors of the IF birds, these aircraft have the specialized equipment required for their direct-support role. The Navy has expressed no interest in expanding this capability to carrier aviation. (The OA-X design did not include an arresting hook, folding wings, or catapult gear.)

The Marine Corps operates four OA-X squadrons—two each at Marine Corps Air Stations Yuma and Cherry Point. The latter's aircraft are equipped with the same jamming package as the AFSOC squadron and benefit from a close relationship with the three remaining Marine EA-6B Prowler squadrons in North Carolina. Marine Corps OA-X aircraft operate as part of the Marine air-ground task force, much like the remaining F/A-18s. Two items make the Marine OA-Xs unique: (1) a wing-mounted probe-and-drogue air-refueling system as well as buddy-refueling capability salvaged from the A-4 Skyhawk and (2) their status as the only OA-Xs to operate from ships at sea, albeit in a very limited fashion. Stored disassembled, OA-Xs embarked for shipboard use are assembled only for one-time flights off *Wasp*-class and *America*-class amphibious carriers for transfer ashore. This capability gives the task force quick access to land-based airpower and increases the number of aircraft available. OA-Xs are assembled below decks, carried by elevator to the flight deck, and launch in a lightweight configuration (one pilot, a partial fuel load, and no weapons or ammunition) for recovery at a land base, where they enter combat service.

Additionally, the Customs and Border Patrol (CBP) branch of the Department of Homeland Security employs a squadron of OA-Xs split between Davis-Monthan AFB, Arizona, and Homestead Air Reserve Base, Florida. Primarily purchased to support counternarcotics efforts along the Mexican border and California coast, as well as in the Caribbean, these aircraft are flown by federal agents, who are not constrained by the military's posse comitatus restrictions and can interdict drug-trafficking aircraft and vessels headed for the United States. Like the Baltic aircraft they inspired, the CBP variants fly with guns and gas only, gaining longer endurance than the more heavily armed versions. CBP aircraft feature the additional communications necessary for successful operations with a wide variety of civil and military users, and some have wake-disturbance sensors intended to locate semisubmersibles. The CBP's consolidation from six interceptor aircraft types to one yielded considerable capability gains as well as cost savings in operations and logistics. The Davis-Monthan aircraft share maintenance facilities with the ANG unit there.

Foreign Users

The USAF is the main user of the OA-X. The most significant foreign user is the Royal Australian Air Force (in partnership with the Royal New Zealand Air Force), followed closely by Colombia and Pakistan. A number of air arms operate a single squadron although squadron size varies: Afghanistan, the United Kingdom, Turkey, Hungary, Morocco, Jordan, Lebanon, Thailand, the Philippines, Singapore, Indonesia, Malaysia, Nigeria, Croatia, and the Baltic states all operate customized variants of the USAF OA-X. Honduras and El Salvador each fly six aircraft, procured under the Regional Aircraft Modification Program, and deliveries for Guatemala and Nicaragua are imminent. As of 2018, procurement efforts for light attack aircraft are under way in Oman, Algeria, Sri Lanka, Portugal (which will give up some of its F-16s for them), and Vietnam. All told, over 800 aircraft are in service or on order in over 20 nations—a far cry from the 15-aircraft buy initially contemplated back in 2010.

The USAF was not the first air force to embrace turboprop-driven light attack. Air forces throughout South America in particular had operated similar aircraft for years before the OA-X program began. Afghanistan's need for a light attack aircraft paralleled the USAF effort and was closely tied to it. After the success of IF, the USAF embarked on an ambitious program to procure an initial 200 aircraft, spiking both interest and demand. Needing a replacement for its PC-9 trainers, Australia jumped at the chance to get a combat-capable aircraft that also could fill training roles and followed the USAF lead immediately, edg-

ing out the Marine Corps as the second major customer.

Consequently, the Australians became the first foreign customer, along with the Royal New Zealand Air Force, with an ANZUS-focused program that satisfied New Zealand's need to reestablish an attack capability, missing since the retirement of its A-4s earlier in the century.

NATO interest followed the USAFE introduction, led by the United Kingdom. The British Ministry of Defence, always on the lookout for cost-cutting options yet under pressure for underresourcing the British effort in Afghanistan, traded a large OA-X squadron for the equivalent number of F.3 and GR.4 Tornados and a handful of RAF-gained Sea Harriers. This move allowed the RAF to keep the same force structure and number of personnel while reducing operations and maintenance costs by 90 percent, compared to operations and costs for older aircraft. RAF OA-Xs have been a common sight in Helmand Province, Afghanistan, as well as in northern Wales. RAF instructors proved invaluable during the Hungarian buy after Hungary returned its leased Griffin fighters to Sweden, and provided the initial cadre for the long-awaited Baltic purchase.

Turkey followed the United Kingdom, even though both programs began simultaneously. Following a model utilized with its F-16 and rotary-wing fleet, Turkey held out for local assembly of the aircraft and subsequently supplied them to Jordan and Lebanon. Turkey will likely become the second-largest OA-X user, after the United States.

Not limited to ANZUS and NATO, the search for a light attack capability extended to Morocco, Pakistan, and Singapore, which faced unique security challenges that put a premium on endurance, flexibility, and ease of operations. The Lebanese, lacking a fixed-wing attack capability since the 1970s, were thrilled to purchase a combat system that even the Israelis could not consider threatening; Jordan followed suit for similar reasons. Lebanese and Turkish ties are particularly close, the Lebanese conducting all of their live-ordnance training drops on Turkey's Konya training range, located within convenient flying distance for the OA-X. Rounding out the decade were Indonesia and Malaysia, which combined their procurement programs; the Philippines, which received its program from US stocks when the Islamist insurgency problem spiked after the elections of 2015; and Honduras, Guatemala, Nicaragua, and El Salvador, which received or will receive OA-Xs under Air Forces Southern's Regional Aircraft Modification Program. Fueled by oil wealth, Nigeria remains the only sub-Saharan air force to complete a purchase, yet on-and-off negotiations with six other African air forces continue. Africa has proven a very tough market for the United States, Brazil, and China, mostly because of the very limited military budgets of most of the continent; South Africa's effort to sell its own light attack aircraft has been equally unsuccessful. Many observers believe that the sale to Nigeria went through only because of the example of the French-hosted NATO squadron in Nice.

Building Partnerships

Although this discussion focuses on the USAF program, one cannot overstate the OA-X's importance in building partnerships. In the 1970s, the USAF used surplus aircraft to build client air forces around the world. Many air forces, particularly in Asia and South America, received both their airlift and combat capabilities from surplus USAF aircraft. C-130s, C-123s, C-119s, and even C-7s rounded out the airlift fleet, while OV-10s, O-1s, O-2s, A-37s, A-1s, and F-5s provided attack and observation capabilities. The Navy contributed A-1, A-4, and A-7 aircraft. Some Marine OV-10s found their way outside the United States as late as the early 1990s. By 2000, US sources of those aircraft models were depleted, leaving only expensive, complex combat aircraft available for export (F-18, F-16, and F-15E), and even F-16s rapidly became unaffordable because

of the standardization effort established by the manufacturer. Surplus F-16As stored in the Arizona desert required $30 to $50 million in upgrade work apiece, making them as expensive as new aircraft. Because the United States could offer no options to air forces that could not afford to buy or operate the F-16, it lost an opportunity for successful engagement—a gap filled by Russia, China, and Brazil. In Africa, China had traded aircraft for mineral, oil, and fishing rights, which should have given it an advantage in aircraft sales, but poor support, customer dissatisfaction, and the fact that it could offer only a 1956 Soviet-based design as a primary trainer/light attack aircraft denied China the edge. Prospective customers considered the Hongdu/Yakovlev L-7 (Yak-152), which started flying in 2009, inferior to a US-designed OA-X.

Other nations often resent what they perceive as a paternalistic US attitude with respect to its domestically manufactured aircraft that the USAF does not operate. For example, foreign customers rejected the ill-fated F-20 Tigershark, an aircraft "not good enough" for the United States to buy. Originally, the USAF had decided to buy 15 OA-X aircraft for the undefined purpose of "building partnership capacity (BPC)," a proposal that would have left it with a niche capability of very limited utility and no outside interest. We avoided that outcome only by an unrelenting effort to explain, in detail, the OA-X's benefits to an air force that had become focused on technology rather than utility.

In late 2010, when the USAF announced it would procure both light attack and light mobility aircraft for its own use, we broke that pattern, and foreign air forces began to look seriously at what the USAF was doing. For small air forces worldwide, the opportunity to engage with the United States and capitalize on the USAF's training infrastructure and tactical knowledge acted as a powerful incentive. Afghanistan's purchase actually preceded the USAF buy, a sequence that caused no end of annoyance among ACC staff members who viewed themselves as originators of the program and elder members of what came to be called the "light attack priesthood."

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The Afghans took delivery of the first six of 20 OA-Xs in 2011, briefly giving them the world's largest OA-X fleet. In reality, Afghan pilots (with USAF instructors in the back) flew the first of these aircraft purely as trainers. The follow-on aircraft arrived fully combat capable and leased back to the USAF for a year to build the experience level of US crews while the Afghans struggled to train enough pilots to build a credible air force. This US-Afghan partnership turned out to be a tactical advantage in some respects, especially during support of Afghan Army units in the field. The Afghan OA-X, with its mixed USAF and ANAAC crews reflecting two different military cultures and featuring proficiency in two languages, eventually became an effective

battlefield coordinator. Though not always trusted to deliver ordnance close to ISAF troops, ANAAC aircrews became such an excellent battlefield interface that the Afghan Army did not share NATO's reluctance to employ ordnance under "danger close" conditions. Later, when the USAF employed larger numbers of OA-Xs, all deployed squadrons in Afghanistan (not tasked to SOCOM) were assigned an Afghan pilot or two (limited by supply, not demand), specifically as a result of the Afghan experience. This gave the USAF squadrons "organic" local knowledge and language skills as well as a built-in interface with the ANAAC. In turn, the Afghan pilots highly desired the opportunity to improve their English language and flying skills. Many experts think the crossflow between USAF and ANAAC crews initiated the rapid professionalization evident among Afghan attack aviators.

The Afghan model was hardly unique. Both foreign and deployed USAF squadrons took full advantage of the two seats to train partner-nation personnel and employ a variety of capabilities in operations. Having foreign "observers" on board surveillance and reconnaissance aircraft had long been a staple of US operations, particularly in Colombia, and the OA-X expanded the envelope to include foreign aircrews. Even in countries that did not welcome the presence of a US advisor, squadrons eagerly accepted advice from crews who had flown directly with US forces. In effect, rather than just examples, the USAF squadrons became mentors and de facto weapons school instructors for many a foreign officer. The two USAF FTUs, both of them necessary to handle the joint and combined training load, owe their continued existence to the investment made by the United States in training foreign OA-X crews.

Of course, foreign countries did not need to possess an OA-X to benefit from efforts at building partnerships. Indeed, possession and employment of the OA-X by the USAF became a key aspect of a partnership-building strategy for a number of countries facing an airpower deficit. The relative ease of deploying a four-ship of OA-Xs for an exercise, a demonstration, or a special mission meant that USAF presence could become more prevalent, particularly in Africa, thus providing a face-to-face training opportunity and offering a highly visible show of US support. In 2015 several Islamic insurgent groups saw an opportunity in the turmoil following the chaotic Philippine presidential election, and the Philippine government's lack of investment in the air force throughout the preceding three decades left the armed forces woefully short of airpower. Accordingly, the United States transferred 12 relatively new OA-X aircraft—along with munitions, spares, and a training system—directly from USAF stocks; moreover, in combination with Australia, New Zealand, and Singapore (which provided pilots), the aircraft granted the Philippines an instant combat capability that first neutralized the insurgents' ability to move via maritime pathways and later provided CAS for Philippine Army forces. Although the Philippine operation was much smaller in scale than Nickel Grass, many observers compared it to that 1973 airlift because it demonstrated US commitment to Philippine security (without a US presence) and may have given a critical boost to the pro-US candidate in the subsequent runoff election.[9]

At the tactical level, the OA-X enabled effective training of partner-nation JTACs. The OA-X's ability to facilitate CAS training affordably and regularly has benefited even allied countries that do not possess them. Both in NATO and particularly in Africa, certain nations have effectively trained terminal attack controllers without actually having very much airpower of their own. This has proven effective in combat operations in Afghanistan, where OA-X crews responding to a request for CAS will often encounter ISAF JTACs who trained with the OA-X—a capability that host countries could not have maintained, given the low availability of legacy fighter aircraft.

Second-Order Effects

A complete list of second-order effects gained by OA-X operators is too extensive to chronicle here. The OA-X, particularly in concert with light airlift aircraft, provides several air forces a wide array of capabilities with a small number of airframes. In addition, acquisition of these aircraft spurred local aviation development since most countries wanted to free themselves from outside support requirements as soon as possible. Nigerian OA-X crews have proven particularly entrepreneurial, using their aircraft for express-delivery services during training sorties, either landing or using a locally developed, parachute-retarded cargo pod. The Nigerian squadron also supports an African JTAC school, and the maintenance crews were instrumental in setting up a flourishing refurbishment center for the Pratt and Whitney PT-6A engine that powers the aircraft.

For the USAF, the second-order effects were significant. The increase in the number of available cockpits enlarged the overall size of the fighter/attack fleet (which had been steadily shrinking since just after Operation Desert Storm), allowing both pilot and navigator training to run at full capacity and ensuring that the shortage of rated staff officers would not last forever. It also had the little-recognized effect of creating a generation of aircrews much more attuned to and expert in the application of airpower in irregular warfare—a class of aviators underrepresented since the Vietnam War.

The presence of OA-Xs in the ANG succeeded in preserving thousands of hours of attack and fighter flying experience that we otherwise would have lost, and in creating a strategic reserve of aircrews. After all, it is much easier (and faster) to upgrade an OA-X pilot to fly the F-35 than to upgrade a student fresh out of pilot training. The benefits of the OA-X squadrons to individual US states went beyond simple job creation (or preservation) by including homeland security and defense roles. OA-Xs have flown well over 100,000 hours of drug interdiction, maritime patrol, border security, postevent reconnaissance, search and rescue, and even air-intercept sorties. In fact, an ANG OA-X operating in support of Joint Interagency Task Force-South gets credit for the largest single bust of a drug-carrying aviation asset.

Planners understood early that the OA-X would help fill holes in JTAC training for the USAF. In 2011 neither the CONUS nor USAFE had enough fixed-wing sorties available to train the existing JTAC force, a problem forecast to worsen as that force expanded and as fifth-generation fighters, with their staggering operations and maintenance costs, came online. The addition of 10 stateside OA-X squadrons largely ended this resource mismatch—current training problems arise more from scheduling difficulties for Army units in Colorado, Kansas, Kentucky, and Hawaii than from a lack of overall capacity.

If any secondary effect by itself qualified as a tremendous advantage, it turned out to be the business aspect, although this element of the OA-X program gained surprisingly little attention once the program began. In view of the operating costs per flying hour (in fiscal year 2010) of the F-16 (over $7,500), A-10 (about $5,000), F-15E (about $16,000), and B-1 (about $33,000), we must consider the OA-X's operating cost of $1,575 per flying hour a bargain.[10] Similarly, the fuel consumption per flying hour of the aircraft is less than 5 percent that of fast jets. For instance, the 26,000 pounds of fuel used by a Lakenheath F-15E for a 1.8-hour training sortie will yield 60 hours of flight time for an OA-X with a partial combat load. True, the USAF had to spend money to save money, but it was equally true that if one ignored the differences between procurement and operations funds, the OA-X program paid for itself—in combat flying hours alone—before the last of the USAF purchase rolled off the production line.[11] Adding to the savings, OA-Xs required no tanker support (except for the Marine Corps birds, which rely on that service's KC-130 tankers)

and became the first USAF fighter aircraft to use the C-17 and C-5 rather than the tanker fleet for intertheater deployment.

Finally, similarly equipped air forces, both with and without formal coordination with the United States, generated a secondary effect for America with respect to building partnerships. Partner nations conducted their own BPC efforts using the OA-X, often engaging where the United States could not. The presence of aircrews and aircraft from Singapore, Australia, and New Zealand did not garner comment in the Philippines in 2015, whereas US presence would certainly have caused an uproar. Those same three countries also proved instrumental in the stand-up of both the Indonesian and Malaysian OA-X squadrons. The New Zealand OA-Xs travel widely, sometimes under a US fund established specifically for the purpose, because the presence of Royal New Zealand Air Force trainers has not disturbed even the most alarmist Pacific basin countries. Similarly, Turkish instructors were involved in Jordan, Morocco, and Lebanon, and the NATO squadron at Nice (which sometimes acts like a French Foreign Legion unit despite its NATO connection) remains closely engaged in Nigeria and Morocco. The presence of a common, transferrable, affordable, modular, interoperable combat aircraft allowed our partners to build their own partnerships worldwide, a trend that shows no signs of abating.

Conclusion

Acquisition of the OA-X in large numbers restored a mix of expensive high-technology capabilities and affordable medium-technology capabilities to the USAF at a time when the twin pressures of a continued drive towards a fifth-generation force and combat operations in Iraq, Afghanistan, and elsewhere placed a severe strain on the USAF. Often derided as a "low tech" or "low utility" platform in the run-up to the acquisition program, the OA-X turned out to be neither, although it remained surprisingly close to the original goal of "low cost." In addition to obvious benefits to the USAF, the attractiveness of a US-flown OA-X allowed construction of what Secretary of Defense Robert Gates described in 2008 as the "100-wing Air Force," representing the combined efforts of many air arms worldwide.[12] Although the nature of the 100-wing Air Force extends far beyond a single, multirole aircraft, the OA-X has done its part. Today, in 2018, OA-Xs represent 36 squadrons' worth of the 100 wings, a substantial impact that 10 years ago existed only on paper. ✪

Author's note. The total USAF OA-X fleet postulated here is larger than the 200 currently necessary to support one sustained, deployed operation (in Afghanistan) while maintaining capability to build partnership capacity effectively in other locations worldwide. Similarly, the notional OA-Xs fill a great many more roles and fly in many more locations than any "BPC-only" construct would allow. The OA-X's African potential remains largely unexplored.

Notes

1. Air Combat Command, *OA-X Enabling Concept* (Langley AFB, VA: HQ ACC/A3F, 23 December 2008).

2. A short-range, point-to-point link that enables delivery of video from an airborne electro-optical/infrared sensor to a ground unit, the remote optical video enhanced receiver (ROVER) is compatible with the Army's one system remote video terminal (OSRVT).

3. "Light Air Support (LAS) Aircraft," solicitation no. FA8615-10-R-ZZ01, Department of the Air Force,

Air Force Materiel Command, Aeronautical Systems Center, https://www.fbo.gov/index?id=01768f9fe4885f2dbd7f7b4cc11aa4ec (accessed 19 March 2010).

4. Imminent Fury, phase two, is a planned combat demonstration of the EMB-314 Super Tucano aircraft as a surrogate light attack aircraft in Afghanistan. The program, which will involve USAF, Marine Corps, and Navy crews, will last for at least six months, starting in the summer of 2010.

5. See Department of Defense, *Base Closure and Realignment Report*, vol. 1, pt. 2 of 2, *Detailed Recommendations* (Washington, DC: Department of Defense, May 2005), http://www.defense.gov/brac/pdf/Vol_I_Part_2_DOD_BRAC.pdf (accessed 6 May 2010).

6. The introduction of laser-guided rockets gave precision capability even to aircraft that had dropped their precision-guided munitions and uploaded additional munitions at rearming and refueling points in forward areas. Army helicopter crews often grumbled about the higher priority for these munitions enjoyed by the OA-X.

7. A NATO exercise program, Ample Train allows one nation's aircraft to refuel and rearm from another nation's air bases. Ground crews are trained in refueling operations, weapons safety and loading, and cross-servicing for multiple NATO fighter types. The program began operating long before the dissolution of the Warsaw Pact.

8. A single C-17 would often fly to remote areas, land, off-load shelters, fuel bladders, fuel, and ordnance, and then depart the same night, leaving no large US cargo plane to draw attention during daylight. An 18,000-pound fuel download from a C-17 typically supports 40 flying hours for the OA-X.

9. During Operation Nickel Grass, the United States resupplied the Israel Defense Forces with modern fighter aircraft to offset heavy losses in the 1973 Yom Kippur War. The USAF transferred aircraft, including 36 F-4Es, directly to Israeli Air Force (IAF) stocks. Featuring USAF camouflage, these aircraft flew in combat with freshly painted IAF insignia.

10. See Table A15-1, "Aircraft Reimbursement Rates" [(per flying hour), fiscal year 2010], in Air Force Instruction 65-503, *USAF Cost and Planning Factors*, http://www.af.mil/shared/media/epubs/AFI65-503.pdf (accessed 6 May 2010). Rough estimates of operating costs for the OA-X come from open sources on costs for the AT-6B and EMB-314 Super Tucano (A.29). Program experience from the IF aircraft indicates that an operating cost of $1,575 per hour is a high estimate.

11. This statement is based on the price of $1.44 per gallon at $60 per barrel at the end of June 2009. HQ AFMC/FMB, https://afkm.wpafb.af.mil/ASPs/CoP/OpenCoP.asp?Filter=OO-FM-BD-11 (accessed 6 May 2010). During the summer of 2008, we were paying $4.07 per gallon.

12. Secretary of Defense Robert M. Gates (remarks to Air War College, Maxwell-Gunter AFB, AL, 21 April 2008), http://www.defense.gov/speeches/speech.aspx?speechid=1231 (accessed 6 May 2010).

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